Size and timing of profits for insurance companies

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Insurance Company Profit

DEPARTMENT OF ECONOMICS

RESEARCH MEMORANDUM

SIZE AND TIMING OF PROFITS FOR INSURANCE COMPANIES
Cost assignment for products with multiple deliveries
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SIZE AND TIMING OF PROFITS

FOR INSURANCE COMPANIES,

Cost assignment for products with multiple deliveries.

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SUMMARY

Insurance policies provide an example of service contracts with multiple deliveries which differ from single delivery transactions in the time profile of revenues and costs. When do we have to date profits forthcoming from these contracts ? Must it be at the moment the contract is signed, to measure the production of the sales department, or at the moment the contract is expiring, when we have the maximum quantity of information about the fulfillment of the contract ? Or, somehow, does the date fit somewhere in between both moments ?

Moreover, the timespan of these contracts stresses the importance of the interest factor in accounting for the costs of these contracts. It turns out that insurance companies use a simple definition of costs: Besides the payments to policyholders, all operational expenses are considered as period costs at the moment of their occurrence. However, some activities contributing to these costs produce services which ought to be matched with future revenues, e.g. initial activities. Existing actuarial literature presents for this case the Zillmer-method, which shows a lack of accounting practice. Other activities produce services that are related to revenues received in earlier periods. Even in a long-run static situation in the volume of active policies, these practices lead to distortion of cost information per product.

The value of the actuarial interest rate deserves special attention. Traditionally, this rate reflects the risk evasion in determination of premiums for long-term contracts. But recent developments, especially in the case of mortgage loan linked life-insurance policies, suggest that the actuarial interest rate should be considered as the customer's opportunity value of interest on his savings. This leads to an erosion of one of the main sources of profit for insurance companies, the result on interest.

The widening of insurance markets that has accompanied European integration, forces the management of insurance companies to be fully aware of their position in the various segments of these markets. A thorough understanding of their profit structure is then indispensable.

Theoretically, insurance policies are a good example of service contracts with multiple deliveries. The concepts of costs put forward in this presentation can be generalized for many other examples of such service contracts.

1. Stating the problem

Accounting for costs has recently enjoyd renewed interest. In global terms, nothing has changed: the profit of a period consists of the sum of the transaction results realized during that period, from which total the costs have to be subtracted which could be allocated to that period but not to the transactions within that period.

New approaches to cost allocation (e.g. Activity Based Costing) differ from those of classical textbooks on accounting, in the distinction between costs which may or may not be allocatable to products or to a certain period.

For convenience' sake, the allocation problem generally is presented with a reference to production processes terminated by single transactions of the goods or services produced. In that case, the moment of realization of revenues, costs and (transaction) profit can be defined unambiguously as the moment of delivery of the product. At that moment the transformation cycle (money - inputs - activities - products - money) has been terminated and the producer can determine the result of the finalizing transaction with the maximum of information. Nevertheless, this information still contains some uncertainty with regard to the evaluation of the assumed consumption of resources by the usage of fixed assets.

A very intersting case, chosen as the subject of this presentation, is presented by service contracts with a long duration, as is the case in banking and insurance policies for instance. In general, these contracts oblige the producer to perform activities, in kind and quantity determined by the customer and/or chance, dispersed over a period of time which is larger than the normal review period. Performance of these activities -and incurrence of the related costs- has not in all cases a direct relationship with the moment and size of the payments made by the customer to the supplier. Matching of costs with revenues in these situations is much more difficult than it is in the single delivery case.

Banks and insurance companies have made sufficient profits until now to permit them to neglect the difficulties of sophisticated cost allocation. When there were no evident reasons for doing otherwise, expenses were considered to be costs of the period in which they were made, generally without allocation to products. Increasing competition, reinforced by the internationalization of markets within Western Europe, led to large scale product development and increasing interest in product costing. This is the practical aspect in stating the theoretical problem: Which allocation of costs and revenues should be applied to the case of products characterized by multiple deliveries per unit of product,

in order to get a sufficient notion of product profitability ? Regarding the three reasons for gathering accounting information:

- the comparison of market price with unit costs
- cost management
- evaluation of inventories,

emphasis will be placed on the first reason in particular, within the context of strategic decision making with respect to the product range.

The scenario of insurance company, one providing life insurance policies, is refered to throughout this presentation. The next section will define the terms used in this presentation, related to insurance concepts.

In section 3, we analyze the activities performed by the insurance company during the contract period and the consequences of these for the -expected- time profile of costs and revenues.

Some appendices are given to show the mathematical derivation of cost concepts presented. The final section will compare these concepts with actual accounting practice in insurance companies and existing approaches in the literature.

2. Relevant concepts in accounting for insurance policies

An *insurance policy* is a contract between an individual customer and a supplier of insurance. In addition to anumber of conditions pertaining to this insurance, the contract defines the *premium*, the amount which the customer has to pay once and/or repeatedly during a period in length eventually defined by an event of chance. Also defined by this contract are the conditions leading to *benefits*, payments made once or repeatedly by the insurance company to the customer or his beneficiaries during a period in length eventually defined by an event of chance.

The *net-premium* is the fraction of the premium that, in terms of actuarial mathematics, is sufficient to cover the insurer's risk on paying benefits. This net-premium is added to the *premium reserve-fund* which is the difference between the actuarial present value of the benefits to be paid in the future and the actuarial present value of the net-premiums yet to be received. *Actuarial present value* is the expectation of the sum of amounts, discounted by the actuarial interest rate, whose probabilities for being paid/received are defined by the relevant mortality tables.

The difference between the premium and net-premium consists of the sum of the *contribution margin* and the *profit margin.* The contribution margin is the amount that is (assumed to be) needed to cover all the costs related to this policy (excluding the benefits to be paid, which are covered by the net-premium). The remaining profit margin, aggregated over policies per period, results in the *gross margin per period.* This gross margin has to cover the period costs not allocatable to products.

Without any loss of generality, it can be assumed that the relative distribution of premiums received for a particular policy, is constant over time with regard to these components (net-premium, contribution margin and profit margin).

The product described by the policy is in numerous cases a basket of services, always containing a shift of risk from the customer to the supplier. In many cases it also contains an exchange between money of different periods. Although these different aspects can be distinguished within a particular policy, an *insurance product* is defined here by a policy type, in which the *units* of this product are defined by the individual policies sold to customers.

> This definition evades the discussion as to whether a policy is a compound product, a combination of separable products or an example of joint production. In this case we assume the first; a policy here is a compound product.
>
> A second problem regarding the product definition has been neglected as well: a particular policy may be a composition of different fundamental policy types, e.g. a combination of deferred annuity with an insurance for disablement pension. Regarding each actual combination as a separate product may raise the number of products to an unmanageable amount. Expertise is needed in defining certain kinds of products.

One unit of a product is delivered to the customer, dispersed over time. In order to realize these deliveries, the supplier has to perform various activities in different periods, each causing costs. In order to receive these deliveries, the customer has to pay the premiums, generally also dispersed over time. There is no reason why the time profile of costs should match spontaneously with the time profile of contribution margins included in these premiums. The only remark to be made in this respect is that, on average (over the population of units within one product), the discounted value of contribution margins equals the discounted value of costs, or at least it ought to do so. But when do we

observe whether or not this is the case ? Will it be during each period or at the end of a policy's timespan ? Owing to the dispersion of the multiple deliveries over time, we lack a natural moment of realization of the exchange. Should we postpone each observation to the finalization of the contract (which offers us the highest degree of certainty in our conclusions), or should we make consecutive observations during the contract period in order to maximize the timeliness of information ? As in many conflicts between certainty and timeliness, we prefere to maximize timeliness; hence, further concepts will be developed under the assumption of consecutive evaluation, period by period, of the observable facts.

The *operating profit* of an insurance company in that case is defined for a particular period as the sum of the following:

* The profit margins included in the premiums due in that period.

* The *result on costs*, which is the difference between the costs realized in performing activities and the coverage for these costs, becoming at disposition out of the contribution fund. This assumes implicitly that contribution margins received are feeding a *contribution fund*, bridging the time gap between receipts of these contribution margins and the performance of the activities for which they are collected.

* The *result on interest*, which is the difference in interest received by the insurance company and the actuarial interest rate applied to the premium reserve-fund, both with regard to the period under review.

* The *result on mortality*, which originates in differences in mortality in the population of policyholders and the estimated mortality.

* Minus the *organization costs*, costs of activities which cannot be related to products, but are performed to make the organization function in the way in which the management stipulates.

The central idea in this conceptualization of profit and costs is the contribution of each period's *facts* to the company's results, facts as there are revenues, differences between costs of activities performed and the contribution out of previously received revenues for coverage of these costs. It is clear that we have to make assumptions in order to evaluate these facts, but these assumptions are not made for reporting as such; they primarily reflect the coststructure of the company, involved in supplying products consisting of multiple deliveries per unit.

3. Activities, costs and assignment.

3.1 Introduction

As suggested by Cooper, we use here the verb 'to assign' to stress the causality between an activity and a (unit of a) product, underlying the recognition that the costs, reflecting the consumption of resources by this activity, belong to the product considered. Or, more general, that the costs belong to the cost object taken into consideration.

The assignment of primary costs to activities is left out of consideration here and taken for granted. The ABC-procedures focus on the relations between activities performed within an organization and its ultimate products, which have to be the basis of the cost structure of these products.

The activities related to products, that are performed by an insurance company, belong to one of the following groups:

- *Product development,* related to the development of new products and the improvement of existing products, preceding sales.
- *Initial activities,* focussing on the contracting of individual policies.
- *Maintenance activities*, which pertain to the relation with the actual customer during the period after contracting but before paying benefits.
- *Distribution activities,* related to the payment of benefits.

Activities which cannot be considered to belong directly to one of these groups are considered as either *service activities* or *management activities*.

Here we do not go further into the problem of the unit costs of individual services. The assignment of service costs to products is generally a three-phase procedure. In the first phase, all costs incurred in order to perform the service activity are gathered. In the second phase, these costs are transferred to the activities consuming this service, and in the third phase the costs of these activities are transferred to the products according to the appropriate hierarchy (unit-, batch- and product level) or to the organization as such (facility level or organization costs). This three-phase approach combines the Dutch accounting tradition with the refreshing ideas presented by the ABC approach [Cf.Bannink, 1992].

Hence we take for granted the assignment of servicecosts to each of the productrelated activities mentioned above. The remaining service costs relate evidently to management and hence are defined into organization costs, together with the costs of other (primary)

inputs into the management activities.

The remaining part of this section will address the problem of how to match the costs of these product-related activities with product-related revenues.

3.2 Costs of product development

Development departments of all kinds share at least one phenomena: they find it difficult to distinguish between maintenance and improvement of skills of the development staff and development activities as such. When we want to emphasize the discretionary character of the costs of these departments and to consider their results as a kind of outcome of a probabilistic process, we do not need to make such a distinction. In that approach, these activities are performed by management's decision, the costs consumed are transferred to the category "Organization Costs" at the Profit and Loss Account of the same period in which they are incurred. Any relation between particular activities and products to be sold in the future is denied, at least taking into account a sufficient, reasonable degree of probability.

The actual practice, allocation of these costs to products sold during the period under review, clearly lacks any reason: development of products has nothing to do with actual products. The argument that the organization bears each period more or less the same amount of development costs and, hence, the actual costs represent the costs in some period or another incurred for the actual products is not valid for two reasons:

(a) stationary investments do result in a situation where periodical investments equal periodical depreciation, but, as well, result in a stationary amount of assets, as is *not* the case in this argument;

(b) cutting development costs does *not* result in cheaper products, but rather in a cheaper and possibly more vulnerable organization.

But, emphasizing that these development activities are manageable, a clear distinction between "projects", goal oriented activities, and "general", input sustaining activities is called for. The time spent on the latter activities has to be allocated to the costs of the time devoted to the former activities.

The development projects result either in failures or in new products. Failures can be considered to a certain extent as the 'normal spoilage' to reach success and, hence, the costs of failures have to be imputed into the costs of the successfully concluded projects.

At the moment a project is considered to be successful, the accumulated costs of that project can be capitalized as 'Goodwill/New Products' on the balance sheet. Untill that moment, the project's period costs can be capitalized as 'Goodwill/Products under Development'.

At the moment a project is considered to be a failure, the accumulated costs (appearing on the balance account last mentioned) can be written off against a 'Fund for Development Failures'. This fund is fed by the 'normal failure rate', applied to successful projects at the transfer from the temporary to the final Goodwill account.

The next thing to do is (comparable with the case of a material asset) to declare a depreciation period and depreciation regime. In the consideration of the project as to be successful, one is not restricted to intrinsic quality aspects, but is of course bound by the commercial aspects as well; there has to be available a 'guesstimate' of the number of policies to be sold during this depreciation period. Thus, the contribution of the development activities to the unit costs of the products concerned can be derived.

My preference is to take these contributions as constant over the depreciation period. This assumption results into an unuity, as is applied in Appendix 1.

Like any other investment of the company, this investment in Goodwill has to earn the company's cost of capital!

In taking this stand, I take explicitly position in the old debate concerning the recognition of assets, a position advocated by e.g. Sorter and Horngren [1962] and Fremgen [1964], a position which is not excluded by the latest version of conceptual foundations of accounting as presented by the FASB, but which is excluded by actual regulations concerning financial accounting [SSAP 13, IAS 9, SFAS 2].

As Sorter and Horngren state: "*Any cost is carried forward as an asset if, and only if, it has a favorable economic effect on expected future costs or future revenues.*" They draw the attention to the conventional focus on physical objects and legal rights instead of the underlying fundamental reality of economic benefits. "This preoccupation with physical evidence often results in expensing expenditures that often should be capitalized. Thus, expenditures for research, advertising, employee training and the like are usually expensed, although it seems clear that in an economic sense these expenditures represent future benefit. ....predictions as to future benefits are explicitly or implicitly made to

warrant these spending decisions. There is some justification for using these predictions as a basis for measuring unexpired costs."

In line with this relevant costing approach, development costs need to be included in the unit costs of a product within a strategic context, because the market price of each product has to cover the costs of all the activities needed to bring that product to the marketplace *and* to provide a margin for coverage of the organization costs, in order to sustain the organization's continuity. However, with regard to the margin for organization costs, I cannot state a tighter constraint than that it has to be positive. Hence, assignment of costs to specific products -as far as cause-effect relations permit- offers a better insight than absorbing 'disputable' cost elements into organization costs.

Results on costs, caused by this element in the coststructure, can originate from two sources:

(a) The development activities, as such, consume too many resources. This may be measured per unit of activity, e.g. a developer's labor hour, or, for a particular project, comparing it with its budget. Or projects are less successful than the normal failure rate expects them to be. This leads to an expenditure variance in the period in which the variance is observed.

(b) The actual number of policies contracted differs from the expected number as used in the determination of the product's unit costs. This leads to a volume variance in the period in which these policies are contracted.

3.3 Costs of initial activities

Initial activities are not restricted to the sales department, although the greater part of them will be performed there. But they pertain, as well, to the collection of the first premiums, the registration of the relevant data of a particular contract and the activities performed in the actuarial department to make the proposal conform with the customer's requirements. We take the registration of these activities and their costs for granted here, but it may be quite clear that this assumption means a large-scale application of Activity Based Costing in the reference company.

These costs, increased by the contribution which a policy sold has to make in order to cover the depreciation of the development costs, have to be matched with the revenues to be received out of this contract. These revenues -the premiums- are defined in the policy.

Based on the policy, mortality tables and experience about premature termination of policies (of this type), the period during which they have to be expected will be given and, thus, will also the period during which these costs have to be depreciated. An applicable algorithm is presented in Appendix 1.

Comparable with the case of development costs, results on costs can be caused in the period in which the initial activities are performed -because expenses vary from their standards- and in the periods in which their depreciation has to be covered by the appropriate part of the contribution margin, because the actual revenue differs from the expected revenue. In so far this variance can be traced to differences between actual mortality and expected mortality, one can raise the question of whether it should be placed into the category 'result on costs' or into 'result on mortality'.

3.3 Costs of maintenance activities

During the contract period, the company has to sustain the relationship with a particular policyholder. This involves activities such as registration of changes in address, providing information requested, collection of premiums, and so on.

When the activity is performed in a period in which a premium has to be paid, the contribution margin should provide in the coverage for a standard amount of costs for these activities. But for some policy types, the maintenance activities still have to be performed when the payment of premiums has already been stopped following the contract terms. In that case, there has to be raised a 'Fund for maintenance activities after premium period' out of the contribution margins received. Analogous to the premium reserve-fund, which pertains to the financial obligations to the customers, this fund reflects the service obligations to the customers.

One can raise the question as to which interest rate has to be applied to match the relevant part of the contribution margin received with the standard costs of these activities performed in later periods. When the company is avoiding risks in the determination of unit costs and the related demand prices, it will prefer the actuarial interest rate. But these prepayments are a kind of debt; thus, the usual interest on debt could be applied, too, which results in slightly more competitive unit costs. We return to this point in discussing the value of the actuarial interest rate (see section 3.6).

Results on costs originate again from two sources: the difference between realized costs

and the standards applied for (a) the consumption of resources per policy in maintenance and (b) the number of policies in maintenance. The latter cause could preferably be denoted as a result on mortality.

3.4 Costs of distribution activities

The period of distribution can last for only one instance (the final settlement of obligations to the beneficiaries) but it can pertain as well to a number of years, for example in the case of the deferred annuity. However, in all cases we have to deal with a situation where the revenues have preceded the costs. Hence there has to be created a "Fund for distribution activities", charged to the contribution margins received.

As the preceding subsection described, results on costs originate from differences between realizations and (a) standard costs per policy in distribution and (b) the expected number of policies in distribution. The latter difference has to be denoted as a result on mortality.

3.5 Results on mortality

In practice,results on mortality are confined to differences between expected changes in the premium reserve-fund and realized changes in this fund excluding changes caused by new policies.

As stated in the preceding subsections, this label should also be attached to the differences in the coverage of costs which originate in differences between the expected and actual volume of policies for which the underlying activities have to be performed.

3.6 Results on interest

In recent years, the result on interest was the main source of income of an insurance company, since the interest received overwhelmed the actuarial interest obligations to the policyholders. There was hardly any bother about structural negative results on costs since the results on interest overcompensated these abundantly.

However, with the introduction of profitsharing policies and, even more, with the introduction of endowment policies whose premiums were linked with the interest rate on accompanying mortgage loans (unit linked policies), this source of profits shrunk. Although it hardly could be imagined that for particular products the result on interest could become a negative one, the relevance of proper management with regard to the

other aspects of the cashflow pertaining to these policies has been increased certainly.

The introduction of the unit linked policies suggests that an insurance company should make a distinction between the interest rate that it realizes by its own active investment behavior and the reasonable opportunity value of the interest rate for the policyholder. The policyholders, of course, experience an unfavorable treatment when their money put into insurance policies generates less interest than they could make themselves. This becomes explicit in the case in which an endowment policy is combined with a mortgage loan granted by the insurance company to the policyholder. The savings comprised into the net-premium rendered only the actuarial interest rate, say 4%, whereas the mortgage loan is granted at the market rate, say 9%. This difference -and the increasing competition- led (via profit sharing policies) to the unit linked policies mentioned above, where the net-premiums are based on the same interest rate as the corresponding mortgage loan and, thus, vary over the contract period. Other product developments pertain to comparable policies where the policyholder can indicate the category of investment opportunities that define the actuarial interest rate to be applied in his contract.

This opportunity rate of interest for the policyholder could be regarded as the transfer price of funds, transferred from the insurance department to the investment department. When the policyholder prefers a high degree of certainty with regard to his premiums to be paid and the benefits to be received nominally, he has of course to accept a lower actuarial interest rate than he would in cases where he takes the risk of adaptation of the premium and/or benefits to changed market conditions.

But when this view is acceptable with regard to the net-premiums and the corresponding benefits, why should it not apply to the time shift between contribution margin received and costs incurred by corresponding activities?

In that sense I use in the appendix the actuarial interest rate for the determination of the elements of the contribution margin as the interest rate specified in the underlying contract to be the opportunity value for the policyholder.

Results on interest will be restricted to the difference between these (!) actuarial interest rates and the transfer rate(s) for funds transferred to the investment department. The positive result to be expected between the income earned on investments and the transfer - rate(s) is an income not earned by the insurance products.

3.7 Standards, expectations and realizations

Although it could be read inbetween the lines of the preceding subsections, it is worthwhile to give explicit attention to the reference base of different cost concepts used.

The unit costs of a particular policy consist of standards for the consumption of resources by the different activities to be performed on behalf of the existence of a contract in terms of that policy during an expected period of time. For the purpose of cost pricing and cost management, it seems to become too detailed to make unit costs dependent on the age, sex and other personal attributes of the policyholder, as is usual for determination of the net-premium. In that view, a unitcost refers to a cohort of policyholders contracting in a particular year. Results on mortality refer to the differences in mortality which this group shows as compared with the mortality tables applied.

The standards for cost consumption are also estimates, based on preceding experience and, when applied in a sophisticated way, taking into account future developments in prices and efficiency (mainly: wages and productivity).

In order to determine these standards per policy one has to have a thorough knowledge of the company's activity structure and the cost structure derived. Thus, from the cost structure desired, one can derive which data have to be observed and registered. Based on these data, the estimates can be made for the standards mentioned above. Ongoing observation then leads to improvement of these standards.

4. Comparison with current literature and practice

4.1 The Zillmer method

The initial costs of a policy overrun the first year's premium in many cases. Taking these costs as costs of the period in which they are incurred leads to lower profits in periods of growth, even to losses in the case of a starting company. Dr. August Zillmer (1831 - 1893) proposed a different definition of the premium reserve-fund by decreasing the value of this fund as defined in section 2 with the (remaining) capitalized part of the initial costs. Consequently, the net-premium has to increase with the depreciation of these capitalized initial costs.

Comparison of this method with the accounting procedure proposed in sections 3.2 and

3.3 reveals the following differences:

(a). The Zillmer method is a mixed bag of obligations to customers and a procedure to match costs with revenues. It suggests that customers would accept a decrease of their claims in the case of when the contract is terminated -e.g. by death of the policyholder- before the end of the contract period mentioned in the policy. Of course this will not be true; in that case the company suffers a negative result on mortality by writing down to zero the remaining capitalized value of initial costs.

(b). Balancing initial costs with the premium reserve-fund implies that the coverage of these costs has to compensate only for the actuarial interest rate. In the proposed procedure, this capitalization has to bear the company's cost of capital.

4.2 Current accounting practice

In current accounting procedures of insurance companies, it can be observed in the financial as well as in the management accounting practice in general to take operational expenses as costs in the periods in which they are incurred. In some cases the actuarial paragraphs in the annual report mention the existence of funds for coverage of expenses to be expected after the receipt of the final premium. I have never observed capitalization of initial costs. Discussing such a capitalization, I have observed many times the argument that such a procedure causes only complications, but after all does not change profits since the amounts to be capitalized will be equal to the amounts consequently depreciated. Well, even in static situations this is not true, since the latter argument overlooks completely the influence of interest in bridging the gap between the moment of capitalization and the moment of depreciation. And in the case of insurance policies, which cover substantial periods of time, this amount of interest can be twice as large as the amounts to be capitalized themselves, as will be shown in appendix 2 ! Not only this, but in the usual case of non-stationarity also the profit figures should reveal a proper matching of revenues and costs. Whether these will over- or underestimate the profit figure conceptually aimed for, depends on the sign of the growth and the composition of the volume of current policies.

It has been observed, too, that operational costs are allocated to the organizational structure, but hardly ever to products or product groups. Occasionally there exists an allocation to 'branches', for example life insurance, insurance against damages, car

insurance and so on. These allocations use rough distribution keys for common overheads. This leads to the conclusion that unit costs cannot be used for their normal purposes, especially not in a strategic context. Regarding the increasing competitiveness of European markets this is an explanation for the growing attention being paid to accounting in insurance companies.

4.3 Hekimian's expected contribution to profit (ECTP)

During the preparation of this paper I found Hekimian's Ph.D.thesis, published in the Harvard series "Studies in Management Control" in 1965 [Hekimian, 1965]. In the introductory chapter of this publication, Anthony states that insurance companies measure only the volume of output, but do not regard the variations in profitability of the different products within that output. This despite the fact that "Managers....are intuitively aware of the fact that....a $ 1000 endowment policy....is ultimately more profitable than a $ 1000 term policy..." One of the possible explanations for this incongruence between the company goal and the accounting representation of production Anthony supposed to be the impossibility "to measure the *actual* profitability of a given policy transaction", at least at the moment of the transaction. Hekimian introduced the Expected Contribution to Profit, to be calculated as "the present value of the premium payments actuarially expected to be made under the policy, *plus* the present value of the interest income expected to be earned on the investment of funds generated by the policy, *less* the present value of the payments actuarially expected to be made to beneficiaries, and *less* the present value of the incremental costs expected to be incurred in servicing the policy over its life."

Although this ECTP is useful for measuring the profitability of sales, in the case of multiple deliveries there is a fundamental difference between sales and production. Moreover, the initial costs have not been included into this ECTP, since it aims to measure the additional profit of the sale of a particular policy, in order to lead branch managers to produce the greatest difference between ECTP and (selling-)costs.

Another difference between the ECTP concept and the concepts presented in this paper can be found in the treatment of results on interest. In Hekimian's approach, all the revenues of interest are reduced to the acquirement of funds, where at this paper's approach a distinction is made between the acquirement activities and the investment activities, each directed to their own markets.

The very remarkable fact, however, is that the fundamental ideas about product profitability in insurancewere already presented in 1965. Discussing his ideas with managers of three insurance companies, Hekimian observed that some of them were of the opinion that ..."cost control is not worth worrying about..". One of the managers he interviewed remarked, "you're 15 years too early with this idea. We're not ready for it yet." Well, it turns out that even this estimate was too optimistic.

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APPENDIX 1. MATHEMATICAL FORMULATION OF POLICY'S COSTS

1. Symbols used.

This appendix is referring to the case of life insurances.

r = cost of capital of an insurance company

i = actuarial interest rate (cf. section 3.6)

n(t) = actual number of contracted policies within period t for a certain product

N(t) = the estimated value of n(t); for convenience' sake the time index, denoting the moment at which this estimate has been made, is omitted

F(k) = the probability that a person out of a cohort of new policy holders will die within k periods following the date of contract

CD(j) = the development costs for a product j

c_1 = standard development costs per policy

c_2 = standard initial costs per policy

c_3 = standard maintenance costs per (active) policy per period

c_4 = standard distribution costs per expiring policy per period

$P(\tau)$ = the premium to be paid in period τ

2. Development costs

The development of a new product is assumed to be a determined action, organized as a project. The assignment of costs to this project and the consideration of the acceptability of these costs with regard to the project's progress is taken for granted. At the end of a certain period t, the project's accepted costs have been accrued to

$CD(j,t) = \sum_{\tau} CP(j,\tau)*(1+r)^{t-\tau}$, where $CP(j,\tau)$ denote the accepted costs of project j during period τ and τ is the period index within the development period.

At the moment of final consideration of the project's degree of success, t_0, the product j is accepted or rejected. When it is accepted, the development costs CD(j) are capitalized as $CD(j) = (1+\lambda)*CD(j,t_0)$, partly consisting out of a transfer of $CD(j,t_0)$, partly out of an addition to the Fund for project failures by an amount of $\lambda*CD(j,t_0)$.

When the project is rejected at t_0, the accrued costs $CD(j,t_0)$ will be written off against this Fund for project failures.

Determination of c_1 then asks for an estimate of product j's lifetime $T_l(j)$ and for estimates

$N(t)$, $t = t_0+1,\ldots,t_0+T_i(j)$

Based on these estimates, c_1 can be determined by

$c_1 = CD(j) / [\sum_\tau N(\tau)*(1+r)^{-\tau}]$ where $\tau = t - t_0$.

Periodically, this capitalized goodwill CD(j) will be depreciated by $c_1*N(t)$; this depreciation is charged against the initial costs $c_1*n(t)$. The difference is a result on costs, charged to the P & L account (volume variance).

3. Initial costs

For convenience' sake, the index j, referring to a particular product, will be hereafter omitted. Nevertheless, the contents refer to a particular product j.

Costs of current initial activities for contracting n(t) policies are compared with their standard value $c_2*n(t)$. The difference is charged as an expenditure variance to the P & L account. Together with the depreciation on development costs c_1 this standard cost per policy c_2 has to be matched with the forthcoming revenues. Assuming the contracted premium period to be T_p, the part of the contribution margin covering these costs, taking into account the interest due, is denoted by m_1. This component of the contribution margin could be determined such that $c_1 + c_2 = \sum_\tau m_1*P(t')*[1 - F(\tau)]/(1+r)^\tau$ for $\tau = t' - t$ and $t' = t+1,\ldots,t+T_p$. So m_1 can be solved by $m_1 = [c_1 + c_2] / \sum_\tau P(t')*[1 - F(\tau)]/(1+r)^\tau$.

If $T_p = 0$, the denominator in the righthand side equals the initial (and only) premium to be paid.

Thus $m_1*P(t')$ represents the depreciation on capitalized initial costs. Over- or undercoverage of this depreciation can only be caused by variance in mortality.

4. Maintenance costs

During the period that a policy is active, which means from the moment the policy is initialized until the moment that the first benefit is paid out, there have to be made maintenance costs. When we denote the length of this period by T_c, it will be clear that $T_c \geq T_p$. When we distinguish between standard costs of collection of premiums, c_{31}, and standard costs of other maintenance, c_{32}, we can determine the expense variance between actual maintenance costs and the standard amount, resulting from multiplication of these standards with the actual number of active policies in a particular period.

The component in the contribution margin that has to cover these standard costs, m_2, has to be derived from $\sum_\tau[c_{31} + c_{32}]*[1 - F(\tau)]*(1+i)^{-\tau} + \sum_{\tau'}c_{32}*[1 - F(\tau')]*(1+i)^{-\tau'} = m_2*\sum_\tau P(t')*[1 - F(\tau)]*(1+i)^{-\tau}$ for $\tau = t' - t = 1,\ldots,T_p$ and $\tau' = t'' - t = T_p+1,\ldots,T_c$

From this equation, m_2 can be solved. Only in the case that $T_c = T_p$ and P(t') is constant, thus $m_2 = [c_{31} + c_{32}]/P$, can there be no variance between coverage out of the contribution margin and the standard costs for maintenance. In other cases, such a variance is clearly caused by differences between actual mortality and estimated mortality within the cohort referred to.

5. Distribution costs

Denoting the length of the distribution period by T_d, this period is defined between the moments $t + T_c$ and $t + T_c + T_d$.

Now it is not only a matter of mortality, but also depending on the terms of the policy whether there is made a payment of a benefit at all. So we denote by f(t') the probability that a benefit has to be paid in period t' within the distribution period.

Standard distribution costs in some period π are given by c_4, differences between actual distributioncosts and this standard, multiplied by the number of distributions, clearly are an expense variance. The standard amount has to be covered by a disposition charged against the Fund for distribution costs:

$\sum_t \underline{c}_4*f(\pi-t)*n(t)$ for $t = \pi - T_c,\ldots,\pi - T_c - T_d$ and $\underline{c}_4$ is the at time t expected value of c_4.

Differences between the standard costs to be covered and their coverage clearly originate in mortality variance as well as in estimation errors. The latter has to be defined into the category 'Results on costs'. Strictly speaking this difference in causes of variance ought to be made in the preceding section too, but the materiality of that difference depends more or less on the type of product, taking into account that in general the receipt of premiums and the incurrence of maintenance costs coincide and hence estimation errors can be absorbed in a redetermination of the contribution margin.

So for a particular period t, the following definition equation holds:

$\sum_\tau m_3*P(t'')*[1 - F(\tau)]*(1+i)^{-\tau} = \sum_{t'}\underline{c}_4*f(t')*(1+i)^{-t'}$

for $\tau = t''-t$ and $t'' = t+1,\ldots,t+T_p$

$t' = \Gamma-t$ and $\Gamma = t+T_c+1,\ldots,t+T_c+T_d$

From this equation m_3 can be solved.

6. Conclusion

In the preceding sections the components of the contribution margin have been defined. For any product j and any period t, the contribution margin by definition equals

$m = m_1 + m_2 + m_3$

and the profit per policy for a subsequent period t' amounts to

$(1 - m)*P(t') - P_n(t')$, where $P_n(t')$ denotes the net-premium.

The company's profit for some period t' hence consists of:

product related profits

$\sum_{j,\kappa(j)} [(1-m_j)*P_{\kappa(j)}(t')-P_{n,\kappa(j)}(t')]$ i.e. profit margins earned on the payments received from policyholder $\kappa(j)$

+ results on costs in period t' with regard to product j
+ results on mortality in period t' with regard to product j
+ results on interest in period t' with regard to product j, defined by the difference between the transfer rate for funds and the actuarial interest rate of product j, the difference of which is applied to the value of the reserved funds on behalf of product j (as well for benefits as for costs to be incurred in the future)

and period-related elements

net-results on interest in period t', defined by the interest income of period t', minus the interest transferred to policies, minus the costs allocated to the investment activities

+ results on costs not related to products in period t'
- organization costs in period t'

APPENDIX 2. A NOTE ON MATERIALITY

1. Symbols used

The same symbols are used as in appendix 1.

It is assumed that the actual number of policies contracted, n(t) shows a constant growth rate g:

$n(t) = (1 + g) * n(t-1)$

2. Statement of the problem

Presenting methods of allocation with the aim to attain an improvement in accuracy with respect to fluctuations over time, one has to be aware of the materiality of this improvement with regard to the related costs of registration. The latter aspect is strongly related to the existing accounting system, so that estimation goes beyond the scope of this paper. A formulation of the difference in cost information for a particular period between the existing methods and the method presented here, is the subject of this appendix. The main aspect of existing methods in this respect is assumed to be that these methods allocate operational expenses as costs to the period in which these expenses are incurred.

Distinction is made between expenses in the present method to be capitalized and expenses in the present method to be covered by cost reserves.

3 Expenses to be capitalized

For convenience' sake we concentrate here on the most important component of the expenses to be capitalized, the initial costs of a policy, c_2. The (standard) expenses in period t in this category are represented by $E(t) = n(t) * c_2$. The costs allocated to period t result from the aggregation of the corresponding elements in the contribution margins of the premiums received during t, originating in the sales of n(t'), $t' = t-1, t-2, \ldots, t-T_p$. In order to reduce the complexity of the problem it is assumed that neither the contribution margin, nor the expense per policy has been changed over time. So

$m_1 = c_2 / \sum_\tau P(t")*[1 - F(\tau)]/(1+r)^\tau$ for $\tau = t" - t'$ and $t" = t'+1,\ldots,t'+T_p$ for all t'. [Cf. Appendix 1 section 3.] A further assumption is that $P(t") = P$. Hence, the costs incurred in t with respect to the policies contracted in t' are to be expected as

$m_1 * n(t') * [1 - F(t-t')] * P = n(t') * [1 - F(t-t')] * c_2 / \sum_\tau [1 - F(\tau)]/(1+r)^\tau$ for

$\tau = t" - t'$ and $t" = t'+1, \ldots,t'+T_p$.

Substitution of $n(t') = n(t) / (1+g)^{t-t'}$ and aggregation over t' results into the expression for the costs C(t) allocated to t:

$$C(t) = n(t) * c_2 * \sum_{t'} [1 - F(t-t')]/(1+g)^{t-t'} / \sum_{\tau} [1 - F(\tau)]/(1+r)^{\tau}$$

The difference between E(t) and C(t) thus is given by

$$E(t) - C(t) =$$

$$n(t) * c_2 * \{1 - \sum_{t'} [1 - F(t-t')]/(1+g)^{t-t'} / \sum_{\tau} [1 - F(\tau)]/(1+r)^{\tau} \}$$

Even when g = 0, there is a difference between E(t) and C(t), originating in the fact that capitalizing initial costs implies that the costs of interest have to be calculated on the book value of the capitalized expenses. As easily can be seen the ratio of both summations is larger than 1 for g = 0, which makes the difference negative (i.e. costs exceed expenses). To get an impression of the magnitude of this difference we use a rough approximation of the survival probabilities 1 - F(t-t') by assuming the force of mortality to be constant [Gerber, 1990, pag.18]:

$$1 - F(u) = (1 + s)^{-u}$$

This assumption overestimates the mortality in the period just after the start of the contract, thus underestimating the impact of discounting. Substituting this in the preceding formula yields

$$E(t) - C(t) = n(t)*c_2*\{1-\sum_{t'}[1/(1+s)*(1+g)]^{t-t'}/\sum_{t'}[1/(1+s)*(1+r)]^{t-t'}\}$$

Let us assume that s = 0,05 (which implies that 25 years after contracting about 30% of the contractors is still alive) and r = 0,12. For zero-growth, the costs exceed than the expenses by a factor 2, which implies that the burden of interest on the book value of capitalized expenses is twice as large as the expenses of one period themselves !

When we assume that the growth rate g = 0,03, this difference is reduced to a factor 1: the omitted interest costs are still about equal to the period expenses on initial activities.

Based on these approximations it can certainly be concluded that the materiality of a more detailed cost accounting is large enough to justify additional costs of accounting, since there are undoubtedly differences between products on this point.

4. Distribution costs

The (standard) expenses in the category Distribution costs are given by c_4 per policy in its distribution phase, denoted by Q(t').

The contribution of period t' to the Reserve fund for distribution costs is an amount m_3

per policy in its premium period T_p. Apart from the differences between expectations on these numbers of policies, there is a time gap to be bridged between the moment of contribution to the fund and the moment of disposition over such reserves. Analogous to the preceding section, this time gap causes interest to be earned by the reservations made, which leads to the conclusion that even in the stationary state the costs will be substantially lower than the expenses of a particular period. But since the relation between Q(t'), the number of policies still in their premium period during t' and the number of concluded contracts n(t) in the preceding periods t, has to be defined per type of contract, we have to restrict ourselves within the scope of this paper to this qualitative conclusion.

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